

1 **WHAT IS CLAIMED IS:**

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3 1. A method of forming a nitride layer on at least one metal or metal alloy biomedical
4 device, comprising: providing a vacuum chamber with at least one biomedical device positioned
5 thereon on a worktable within the vacuum chamber; reducing the pressure in the vacuum
6 chamber; introducing nitrogen into the vacuum chamber so that the pressure in the vacuum
7 chamber is about 0.01 to about 10 milli-Torr; generating electrons within the vacuum chamber to
8 form positively charged nitrogen ions; providing a negative bias to the worktable so that the
9 positively charged nitrogen ions contact the biomedical devices under conditions such that a
10 nitride layer forms on the at least one prosthetic device.

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12 2. The method of claim 1, wherein the biomedical device is made of Ti-6Al-4V alloy,
13 Ti₆Al₇Nb, commercially pure titanium, or CoCrMo alloy.

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15 3. The method of claim 1, wherein the bias of the worktable is maintained to provide a
16 temperature of about 700 and about 900 degrees Centigrade.

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18 4. The method of claim 1, wherein the nitride layer has a thickness of at least about 1
19 micron.

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21 5. The method of claim 1, wherein the worktable has a negative bias voltage of about 100 to
22 about 2000 volts.

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24 6. The method of claim 1, wherein the electrons are generated using a filament.

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26 7. The method of claim 1, wherein the vacuum chamber is reduced to a pressure of less than
27 10⁻⁵ Torr prior to introduction of the nitrogen.

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29 8. The method of claim 1, wherein nitrogen and an inert gas are introduced into the vacuum
30 chamber.

1 9. The method of claim 1, wherein the nitride layer has a thickness of about 1 to about 4
2 microns.

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4 10. The method of claim 1, wherein the nitride layer has a thickness of about 3 to about 4
5 microns.

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7 11. The method of claim 1, wherein the nitrogen ions impact the biomedical devices
8 omnidirectionally.

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10 12. The method of claim 1 wherein the temperature is at least about 300 degrees Centigrade.

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12 13. The method of claim 1, wherein the biomedical device contains titanium.

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14 14. The method of claim 13, wherein the temperature is at least about 800 degrees
15 Centigrade.

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17 15. The method of claim 1, wherein the biomedical device contains cobalt.

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19 16. The method of claim 1, wherein the temperature is at least about 650 to about 750
20 degrees Centigrade.

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22 17. The method of claim 1, wherein the pressure is reduced to less than 10^{-5} Torr prior to
23 introduction of the nitrogen.

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25 18. The method of claim 1, wherein the pressure is reduced to less than 10^{-6} Torr prior to
26 introduction of the nitrogen.

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28 19. The method of claim 1, wherein the electrons are generated using a alternating current
29 power supply.

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1 20. The method of claim 1, wherein the worktable is biased using a direct current power
2 supply.

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4 21. An apparatus for forming a nitride layer of at least about 1 micron on a biomedical
5 device, comprising: a vacuum chamber, at least one source of electrons, at least one nitrogen
6 inlet, at least one worktable having a negative voltage bias, wherein the vacuum chamber
7 contains nitrogen at a pressure of about 0.01 to about 10 milli-Torr.

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9 22. The apparatus of claim 21, wherein the source of electrons is a filament.
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11 23. The apparatus of claim 21, wherein the negative voltage bias is about 100 to about 2000
12 volts.

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14 24. A biomedical device made of metal or metal alloy which comprises an outer nitride layer
15 having a thickness of at least 1 micron.

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17 25. The device of claim 24, wherein the nitride layer is 3 to 4 microns thick.

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19 26. The device of claim 24, wherein the biomedical device is made of Ti-6Al-4V alloy,
20 Ti₆Al₇Nb, commercially pure titanium, or CoCrMo alloy.

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